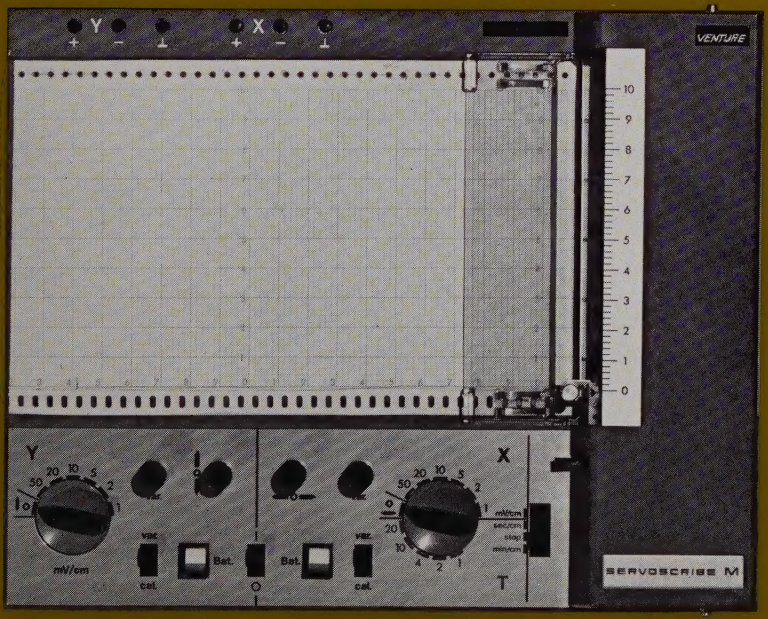
SERVOSCRIBE M

xy/yt Potentiometric Recorder

INSTRUCTION MANUAL



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VENTURE

xy/yt POTENTIOMETRIC RECORDER

SERVOSCRIBE M
TYPE RE 501.20

INSTRUCTION MANUAL

Publication No. T.830

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SECTION 1.
GENERAL INFORMATION

1. INTRODUCTION

The SERVOSCRIBE M is a combination of a potentiometric recorder and a coordinate recorder. In the one case a time dependent d. c. voltage record is produced y = f (t) whereas in the other case the record shows the relationship of two d. c. voltages y = f (x).

The instrument can also be used to record non-electrical values (physical, chemical, biological, etc.) where these values can be converted to a low level d. c. signal by utilising suitable transducers.

The compactness and versatility of the SERVOSCRIBE M are achieved because the chart drive unit is also used as a servo system for the second (x) axis of the coordinate recorder.

By the use of solid state circuits and d. c. motors the total power consumption is reduced to a level that enables the instrument to be operated directly from self-contained dry cells with all the inherent advantages, such as independency of mains supply, freedom from parasitic voltage interference, etc. Records can be made on chart rolls or on graph sheets.

The use of wax pressure sensitive recording paper reduces routine maintenance to a minimum; it is, however, also possible to produce the recording with a felt nylon-tip pen on standard paper. The SERVOSCRIBE M can be used in a horizontal or inclined position. The function of all controls of the SERVOSCRIBE M is illustrated on page 22. All mechanical and electrical components are mounted on the top panel and easily accessible for servicing after the removal of the top cover plate and instrument case.

The bottom of the recorder case houses the dry batteries (4 mono-cells for each channel) which are inserted from the underside. When chart rolls are used, the full roll is housed in a recess in the side of the case.

2. TECHNICAL DATA

Unless otherwise indicated the following electrical data are valid for both the Y and the X channel.

Sensitivity Steps and Full Scale Values (calibrated):

Sensitivity		1	2	5	10	20	50	mv/cm
Full Scale Value	Y axis	10	20	50	100	200	500	mV
	X axis	15	30	75	150	300	750	mV

Intermediate Ranges: Each fixed step in sensitivity can be continuously increased up to 2.5 times the normal value. This allows the full scale deflection to be adjusted for any measured value between 40% of the smallest and 100% of the largest calibrated full scale value.

Recording Width: Y axis 10cm (4 in. approx.)
X axis 15cm (6 in. approx.)

Accuracy (Class 1): Indicating and recording errors are ±1% of the selected full scale value. For intermediate ranges accuracy data refers to the selected f.s. value.

Resolution: (=half dead band): ±0.5% of the selected full scale value

Response Time (over the whole recording width): Y axis approx. 0.5 sec
X axis approx. 0.7 sec

Writing Speed: approx. 20 cm/sec

Frequency Response: A sine function of 1 Hz and with a p.p. value of 2/3 of the recording width is reproduced with a 10% drop in amplitude.

Input : Floating The minus or the plus terminal can be connected to the screen.

Input and Source Impedances:

Sensitivity	mV/cm	1	2	5	10	20	50
Input impedance							
on balance*	MΩ	1	2	5	10	15	25
off balance	kΩ	10	20	50	100	150	250
Source impedance							
reference range**	kΩ	1	2	5	10	15	25
max. allowable***	kΩ	10	20	50	100	150	250

* minimum values

** without additional error from source impedance 0 up to the stated values

*** at the stated limits the dead band may increase up to 1.5 times its normal value, i.e. up to 1.5%.

Influence of Parasitic Voltages (interference):	The influence remains less than 1% if the following voltages are not exceeded: a. Between earth and screen (common mode interference): 40 V* for d. c. and for frequencies up to 10 kHz. 40V for frequencies from 10 kHz to 100 kHz b. Between the two screens (interaction): 40V for d. c. and for frequencies up to 100 Hz 10V for frequencies from 100 Hz to 1000 Hz c. Between plus and minus terminal (series mode interference): 50% of the selected full scale value for frequencies from 25Hz to 1 kHz 500% of the selected full scale value for frequencies from 1kHz to 100 kHz
Note *	In this case there is no additional error but for safety reasons the maximum parasitic voltage is limited to 40 V.
Temperature Error:	No additional error between 20 and 25° C. Less than 0.5% per 10° C from -10 to +50° C
Reference Position:	Horizontal or any inclined position (without additional error)
Influence of External Magnetic Fields:	Less than 1% for an a.c. (50 Hz) induction of 0.5 mT (1 mT = 10 Oersted = 800 A/m)
Zero Settings:	The zero position can be continuously shifted over the whole recording width (10 or 15 cm resp.): in addition, the input voltage can be suppressed up to that value which corresponds to the recording width
Recording:	With sapphire tipped stylus on wax paper or with felt nylon-tip pen on standard paper.

Recording Paper:		a) Chart rolls of 12cm width and 16m length b) Graph sheets 12 x 19cm
Chart Drive (for yt recording):		By means of a d.c. motor with electronic speed control:- 1, 2, 4, 10, 20 min/cm., i.e. 60, 30, 15, 6, 3, cm/h 1, 2, 4, 10, 20 sec/cm., i.e. 60, 30, 15, 6, 3, cm/min Accuracy: ±1% of the chosen speed at temperatures 20° C to 25° C Temperature influence from -10 to +50° C: less than 1% per 10° C
Working Life:		Servomotors and Tacho-generator approx. 5000 hours (at a mean writing speed of approx. 0.1 cm/sec) Batteries approx. 50 to 100 hours in continuous operation (current consumption approx. 50 to 100 mA)
	Note:	For replacement of servomotors and tacho-generators - see "Spares and Service", paragraph 8, page 20.
Test Voltage:		500V a.c. (screen to case and screen to screen)
Power Supply:		8 Mono cells 1.5V, TYPE HP2, 3.4 dia. x 6.1 cm. High power leak resistant. (IEC-R 20, 3 4dia x 6 1cm leak resistant)
Dimensions:		20.5 x 26 x 10.5 cm. (8.1 x 10.25 x 9.1 in.)
Weight:		Approx. 2.8 kg (6.2 lb.) without batteries, approx. 3.5 kg (7.7 lb.) with batteries

SECTION 2.
OPERATING INSTRUCTIONS

1. UNPACKING AND COMMISSIONING THE RECORDER

1.1. Contents check

The Servoscribe M xy - yt recorder, type RE 501.20 is normally equipped with a transparent cover and take-up spool for the chart roll and is supplied complete with the following accessories:

Fitted into the recorder:
- 1 sapphire stylus (for wax paper)
- 1 chart roll (wax paper)

Inserted into the expanded polystyrene packing box:
- 1 chart roll (standard paper)
- 1 spare sapphire stylus
- 1 each felt nylon-tip pens, red and blue
- 1 each graph pad (25 sheets) of wax and standard paper
- 8 mono cells 1.5V (IEC-R 20), HP2 or equivalent
- 6 connecting leads
- 1 screwdriver
- 1 Instruction Manual

2. OPERATING PROCEDURE

(The numbers in brackets refer to the diagram on Page 22)

2.1. Set both sensitivity switches (10) and (13) to "0". Set switch (9) to "stop" and battery switch (14) to "0".

2.2. After loosening the two slotted screws on the underside of the instrument remove the bottom plate and insert the mono cells observing polarity. (Put the 4 batteries next to the spring contacts in first - see Figure 1.)

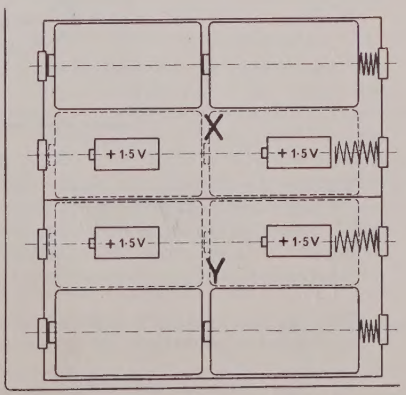


Figure 1.
Layout of battery compartment

(Note direction of polarity)

Remove the batteries from the instrument if the latter is not to be used for a prolonged period.

Take care that the contact faces of the cells are exposed and clean. With the battery switch (14) in the "On" = I position the pointers of the two meters (12) should settle approximately in the middle of the white zone. If a pointer does not deflect at all or remains within the red zone this means that the cells of the corresponding channel have either a bad contact or are partly or wholly exhausted. (The identification of each set of 4 cells to the "X" or "Y" channel can be seen from the markings in the battery compartment.)

Note: To avoid unnecessary discharge of the batteries always set the battery switch to "0" when the instrument is not in use. For current consumption, see "TECHNICAL DATA".

2.3. With the pen lift lever (8) raised insert the stylus (6), unless already in position, into the fork of the pen support and push home until it locks. The slotted stud in the pen carriage must be in its lower position, i.e. flush with the upper face of the carriage (see illustration on page 14.) If this is not the case push the stud and turn by approximately 90° until it is in the locked position, (using the screwdriver provided).

2.4. Insert take-up spool with chart roll into the slots on both sides of recess in the case and push home until both pivot pins engage. (To remove the spool - push release lever - see Figure 2.)

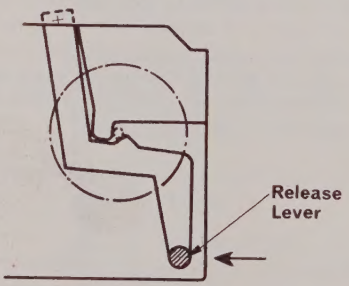


Figure 2.
Correct position
of chart feed spool.

2.5. Remove the transparent cover* and insert the chart paper from the right underneath the guide ruler (5) with the pen lift lever in the raised position, until the pin wheel (4) engages in the perforations. It is then moved forward by means of the knurled wheel (3) approximately up to the left hand edge of the SERVOSCRIBE M.

2.6. With the pen assembly lowered down the SERVOSCRIBE M will now be ready for operation and recording.

* The cover is removed by opening it beyond the stop, until the pins ease out of the bearing holes. The pins will re-engage if the cover is put on the instrument and light pressure is exerted downwards.

3. INSPECTION ON RECEIPT

3.1. To ascertain that the instrument has been received in good condition the following tests are recommended, apart from a mechanical inspection. The tests included under paragraph 3.1.1. for which no additional equipment is required, will suffice as a rule to find out if damage has occured during shipment. The tests indicated under paragraph 3.2. will provide a more detailed check of the recorder; they have the additional advantage that a user, not yet conversant with the SERVOSCRIBE M will become familiar with its operation.

3.1.1. Performance check without external voltage source

a. "Y" - channel
Sensitivity switch "Y" to position "0"
Change-over switch "var-cal" - any position

With the battery switch "on", the pen must move over the whole recording width when the zero control is operated.

Note: Beyond the ends of the scale the movement is limited by stops. However, the servomotor will continue to rotate with the clutch slipping.

b. "X" - channel:
Sensitivity switch "X" to "0"
Slide switch "X - T" to "mV/cm"
Change-over switch "var-cal" to any position

With the battery switch "on", the chart must move from left to right and vice-versa over a total length of approx. 17 cm (at least 16.5 cm) when the zero control is operated.

c. Time base "T":
Pen to be raised (by lever (8))
Sensitivity switch "Y" to "0"
Sensitivity switch "X" to "4" (blue)
Slide switch "X - T" to sec/cm"
Socket "X" to be connected to " ⊥ "

When the battery is switched on, the servomotor "X" drives the chart strip at a speed of 15 cm/min (corresponding to 4 sec/cm). While observing the second hand of a watch lower the pen (time "0") and raise it again after 60 seconds. The length of the straight trace thus recorded should be 15 cm (±0.15 cm). It is evident that for a higher accuracy, this check can be extended over a multiple of 60 sec. and that it can be carried out accordingly at other chart speeds.

3.2. Performance check with external voltage source

a. With the help of an adjustable d.c. source and a precision millivoltmeter (d.c. potentiometer) or a calibrated voltage source (such as the Venture d.c. Millivolt Source type 5100), it is possible to check the accuracy of the SERVOSCRIBE M at any of its full scale values (see "TECHNICAL DATA") as well as at any intermediate value.

b. Connect the measuring voltage to the sockets "+-" and join the screen " ⊥ " to either pole (preferably that with the lower potential to earth). Set change-over switch "var-cal" to "cal", slide switch "X-T" to "mV/cm".

c. With the sensitivity switches (10 and 13) set to "0", adjust the zero position by means of the zero control knobs (15) as follows.

"Y" axis: Set the pointer to the zero mark of the scale by means of control ⊙

"X" axis: As there is no fixed scale, the moveable chart paper takes on the role of a scale

d. Move the chart (by turning control -o- clockwise) to the right up to the stop (servomotor "X" will continue to idle), then go slightly backwards until the first numbered vertical chart line appears underneath the stylus. This line should be marked as it will serve as the zero line for the ensuing measurements, the full recording width of 15 cm being now available (on the chart to the right of the zero line).

e. If no adjustable source is available, or if one wishes to check the electrical performance in a simpler manner, the following method can be employed:

With the use of a voltage source of 1.5 V (e.g. mono cell) and a potential divider 1 : 100 a measuring voltage of approx. 15 mV is produced. Equally a different source with corresponding divider can be used; the accuracy of of the components is irrelevant, provided they possess at least short term stability - see Figure 3.

The following tests can now be carried out (the diagram shown is for the "Y" axis but by analogy is also valid for the "X" axis)

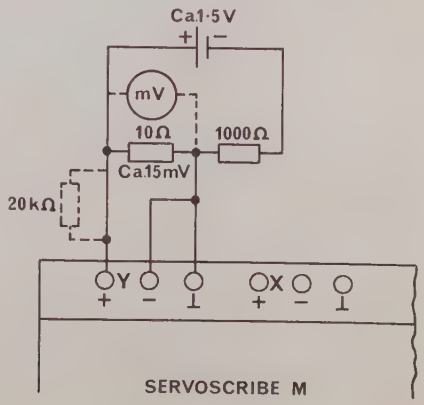


Figure 3. Diagram of simple test circuit

3.2.1. Deflection and Response Time. Change-over switch "var-cal" to "cal".

After adjustment of the zero position (as described above) set sensitivity switch "Y" from "0" to "2 mV/cm". The deflection, amounting to approximately 8 cm, should be marked by slight rotation of the "X" zero control -o-. If a precision millivoltmeter is available or the Venture d.c. Millivolt Source type 5100 is used, the accuracy can also be checked; the deflection in cm must be equal to half the indicated millivolts (tolerance: ±0.1 cm for "Y"; ±0.15 cm for "X"). The response time, after switching the voltage source off and on, should equal approximately 0.5 sec.

3.2.2. Intermediate Ranges. (Variable Sensitivity)

Set the sensitivity switch to "5 mv/cm": the deflection will decrease to approximately 3 cm. With switch "var-cal" set to "var", it must be possible to obtain the original (marked) deflection by means of sensitivity control "var".

3.2.3. Zero Suppression Change-over switch "var-cal" to "var".

Re-adjust the zero position, set sensitivity switch back to "2 mV/cm" and adjust, by means of control "var" the sensitivity so that full scale deflection (10 cm for "Y", 15 cm for "X") is obtained. By rotating the corresponding zero control (15) it must be possible to bring back the stylus (or the chart) steadily to its zero position.

3.2.4. Influence of the Source Impedance

An additional test can be carried out to check the accuracy at the maximum allowable source impedance by inserting and short-circuiting, a 20 kΩ resistor into the "+" input lead (see Figure 3). When opening the short circuit the deflection should remain practically unchanged.

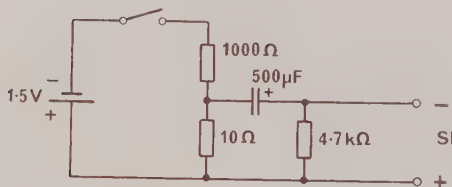
If this test is made with the inclusion of a precision instrument as described under 3.2.1. the tolerances will now be: ±0.13 cm for the "Y" and ±0.2 cm for the "X" axis.

3.2.5. Resolution

For determining the dead band (twice the resolution) the pen support should never be deflected mechanically by hand. A simple circuit (see Figure 4) allows the dead band to be determined in the 50 mV/cm range. By opening and closing the switch a deflection will be provided with consecutive steady return to the balancing position.

The difference between the two final indications is the dead band (see Figure 5). This should not exceed 1 % of the recording width. It may rise up to 1.5 % when an additional resistance of 250 kΩ is inserted into the "+" input lead.

Figure 4. Test circuit for dead band check



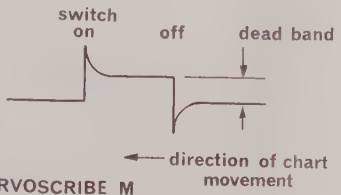


Figure 5. Determining the dead band

4. FURTHER OPERATING INSTRUCTIONS

4.1. Operation as a Potentiometric (yt) Recorder

After the procedures as described in paragraph 2 the SERVOSCRIBE M is ready for operation as a yt recorder with sapphire stylus on wax paper (regarding the use of felt nylon-tip pens (see paragraph 4.3.). The correct use of the different controls and switches will, as a rule, be evident from their markings and from the illustration and captions on page 22 ; in case of doubt, refer to paragraph 3 and the operating methods described therein.

The desired chart speed is selected by means of the chart speed switch for "T" (10) and setting the slide switch (9) to the corresponding speed range (min/cm" or sec/cm"). * With the slide switch a gearing is changed in the ratio 1 : 60. In the centre position "stop" the chart drive is switched off, but the motor idles at the speed selected by switch (10), (see also Section 3 para. 1 and 2).

* Note It is unnecessary to set the chart speed switch to any of the black figures (1.... 50 mv/cm) because each of these positions is electrically connected to the diametrically opposite one, in the T mode, e.g. 4 (blue) = 5 (black).

Settings "T" on SERVOSCRIBE M	min/ cm	sec/ cm	1	2	4	10	20
Chart Speed	mm/ h	mm/ min	600	300	150	60	30

If the chart drive is not required, e.g. because the SERVOSCRIBE M is to be used as an indicating instrument, set the sensitivity switch to zero, with slide switch 'X-T' to 'STOP'. This makes the motor and the tacho-generator, coupled to it, inoperative.

The time axis of the chart has (and equally the "Y" axis) a centimetre graduation and is numbered from 1 to 10. To set the instrument to a definite time mark e.g. initial time "0" rotate the knurled wheel (3) with the slide switch in position "stop".

When the zero for "Y" is adjusted, the sensitivity switch (13) and the chart speed (blue figures, 1.....20) are chosen, the recording is started by moving the slide switch from "stop" to "min/cm" or "sec/cm" respectively.

At the end of a recording period always switch off the batteries in order to prolong their life.

For short recording lengths (maximum 15 cm) one can also use the graph sheets Zb 315 and Zb 316; this is particularly recommended when it is desired to file a single diagram as a measured record. Graph sheets are inserted in the same way as chart rolls (see 2.5.) from right to left underneath the chart guide.

4.2. Operation as a co-ordinate (xy) Recorder

To set a graph sheet in the correct initial (zero) position for xy recording proceed as follows:-

Battery switch (14) to "0"
Sensitivity switch (10) and (13) to "0"
Turn zero control -o- fully anticlockwise
Slide switch (9) to "mV/cm"
Turn knurled wheel (3) fully to right

Insert graph sheet from the right underneath the chart guide and, simultaneously rotating the knurled wheel, transport it until one or two sprockets of the pin wheels engage with the perforations. When the instrument is switched on, the graph sheet will be transported to the extreme left. The stylus should now be a few millimetres to the right of division 15.

Check: By rotating zero control -o- it must be possible to move the whole recording width (0.....15) underneath the stylus.

The SERVOSCRIBE M is now ready for use as an xy recorder. The function of the different controls will be evident from their markings and from the illustration and captions on page 22; when in doubt, refer to the operating methods described in paragraph 3.

Note: It is also possible to use the chart rolls instead of graph sheets for xy records because the former can also be run backwards over the limited length of 15 cm. In this case the adjustment of the initial position described above is not needed and it is only necessary to mark the zero position for the x axis, as described in paragraph 3.2.d.

4.3. Recording on Standard Paper with Felt Nylon-Tip Pen

If a thicker and indelible trace is required, a felt nylon-tip pen and standard paper can be used instead of the Sapphire stylus and wax paper (see "order code" paragraph). For this purpose a felt nylon-tip pen must be inserted in place of the stylus whilst the pen lift lever (8) is in the raised position.

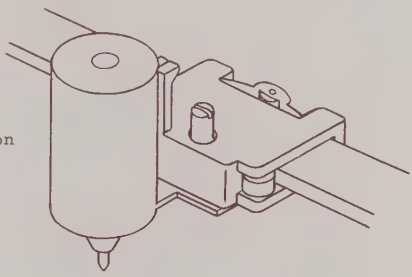


Figure 6.
Ink cartridge fitted showing correct position of pressure stud (i.e. released.)

To obtain the correct writing pressure the slotted stud must be turned until it is in the raised position (see Figure 6). For this purpose a screwdriver is supplied with the instrument.

When delivered the felt nylon-tip pen is hermetically sealed to prevent drying out. It is therefore necessary to remove (preferably with a knife) the capsule at the writing tip and the stopper together with the sealing compound at the top of the cartridge.

After inserting a standard recording medium (chart strip or graph sheet) and lowering the pen the instrument is again ready for recording.

Always lift the felt nylon-tip pen away from the paper when not recording. One felt nylon-tip pen will last for a total trace length of 1000 - 2000 m.

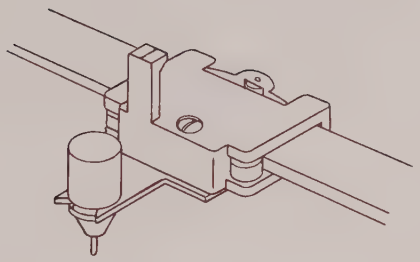


Figure 7.
Pressure stylus fitted showing correct position of pressure stud (i.e. engaged)

4.4. Recording on Wax Paper with Sapphire Stylus

To increase the writing pressure push the slotted stud and turn clockwise or anticlockwise (approx. 90°) until it is in the locked position, using the screwdriver provided - see Figure 7.

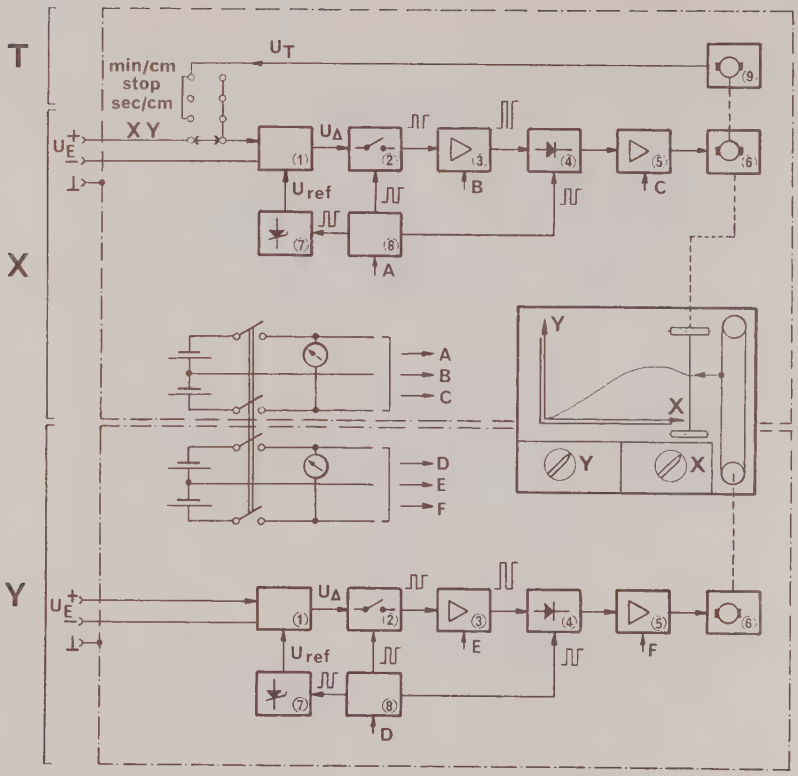


Figure 8. Block Diagram of the SERVOSCRIBE M

1. Compensating bridge consisting of:
   Input bridge with sensitivity switch
   Change-over switch "var-cal"
   Sensitivity control potentiometer "var"
   Zero control potentiometer
2. Chopper
3. a.c. Amplifier
4. Modulated rectifier
5. d.c. Amplifier
6. Servomotor
7. Reference voltage source
8. Square wave oscillator
9. Tacho-generator
10. Servopotentiometer

SECTION 3.
PRINCIPLE OF OPERATION AND SPECIAL INSTRUCTIONS

1. COORDINATE xy RECORDER

1.1. The measurement is potentiometric in both the x and the y channels. A d.c. motor displaces the slider of the servo potentiometer until the compensating voltage equals the input voltage. The servopot of the y channel is linked to the pen carriage and that of the x channel to the chart drive mechanism.

1.2. The compensating voltage is supplied by a compensating bridge which is fed from a reference voltage source. During balancing, the compensating voltage is either smaller or larger than the input voltage, whereby the compensating bridge becomes out of balance and generates an error signal. This latter is amplified by a chopper amplifier and drives the servomotor via a final stage with d.c. feedback. The motion of the servomotor is stopped when balance is achieved. The modulating voltage, at a frequency of approximately 450 Hz, for the electronic chopper and the modulated rectifier is supplied from a square wave oscillator which also delivers the supply voltage for the electronically stabilized reference voltage.

1.3. The compensating bridge is (apart from the servo potentiometer) also affected by the sensitivity control potentiometer "var" and, by the zero control potentiometer which allows the zero to be displaced over the whole scale width and to be suppressed to a value equal to full scale.

2. TIME COINCIDENT yt RECORDER

2.1. The operating mode of the y channel remains unchanged. The circuit of the x channel is changed in such a way that the output voltage of a tachogenerator linked to the servomotor, is compared with a part of the reference voltage. The difference between the two voltages is fed to the x amplifier which controls the input voltage to the servomotor so that its speed remains constant. A tapped potential divider, connected across the output of the tachogenerator, allows the speed of the servomotor to be changed in five steps. An additional change of speed 1 : 60 is effected by a gear drive.

3. SPECIAL MEASURING INSTRUCTIONS

3.1. Earthing Conditions and Interference

The inputs of both channels are floating; each of them is shielded

by a separate screen (guard) which is connected to the socket marked with the symbol "⊥". These screens prevent leakage currents and parasitic a.c. voltages from reaching the measuring circuit. The best way of connecting the screens depends upon the earthing conditions in the external measuring circuit and upon possible parasitic voltages. The existence of such voltages can be recognised by jerks in the pen movement.

If the earthing and interference conditions in the external circuit are not known, one should establish by trial whether connecting the screen to the plus or minus terminal or to a measuring earth (if available) gives better results. When in doubt connect the screen to minus.

If the earthing conditions of the external circuit are known, the screen should be connected to that pole which is nearer to earth (e.g. earthed by capacity). The same procedure is valid for parasitic voltages i.e. the screen to be connected to the pole nearest to earth.

If the earthing conditions are not defined and the parasitic voltage appears between the two inputs, each screen should be connected to that pole which has the smaller impedance to the parasitic voltage source.

EXAMPLES

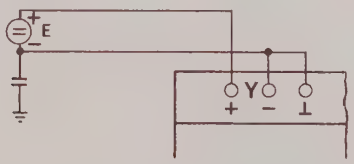


Figure 9. Minus pole of input E earthed

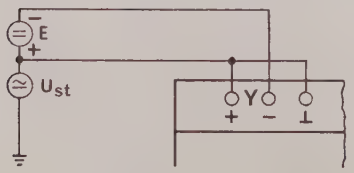


Figure 10. Parasitic voltage U_{st} appears between input voltage E and earth, the plus pole being nearer to earth

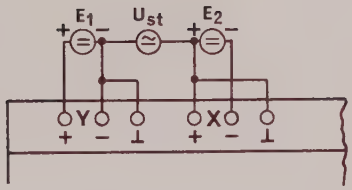


Figure 11. Parasitic voltage U_{st} appears between the two inputs E_1 and E_2, the minus pole of the Y channel and the plus pole of the X channel being nearer to U_{st}.

When using the SERVOSCRIBE M as a potentiometric (yt) recorder it may be necessary, in cases of extreme interference (e.g. in the prescence of strong electrostatic fields), to join together all three sockets of the X channel and to connect them to earth in order to avoid additional time keeping errors.

3.2. Source Impedance and Dead Band

To avoid erroneous results it is essential to pay attention to the maximum values indicated in Section 1, paragraph 2, "TECHNICAL DATA". With increasing source impedance, the values of dead band and response time are also increased.

When in doubt, if the resistance of the external measuring circuit is not known, it is possible to ascertain whether the measurement was correct by using the following method. Switch temporarily to the next higher range, return to the original one, switch to the next lower range and return again to the original one. The difference between the two equivalent readings should not exceed the permissible dead band. If it does, the measured results must be interpreted with caution.

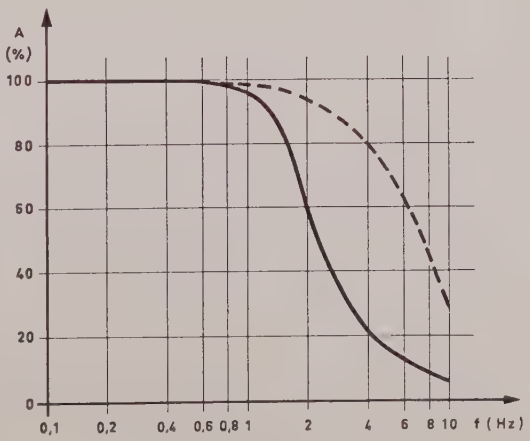


Figure 12. Typical curves showing the amplitude "A" of the deflection (as a percentage of the correct value) as a function of the frequency "f" of the input signal.

——— for a p.-p. value of input signal, equal to 2/3

– – – – for a p.-p. value of input signal, equal to 1/10 of the full scale value.

3.3. Frequency Response

When recording rapidly varying events, recording errors may occur as a result of the dynamic response. The magnitude of the respective error depends upon the frequency as well as the amplitude of the signal. The response time, given with 1 Hz in the "TECHNICAL DATA", may serve as a guide, together with reference to Figure 12.

Bearing in mind that the recorder has a nearly constant writing speed the dynamic errors will decrease with decreasing amplitude. In border line cases one may obtain a truer record of the input signal by switching over to a higher (less sensitive) range.

4. MEASURING RANGE EXTENSION

4.1. By means of the appropriate potential dividers and shunts the use of the SERVOSCRIBE M can be extended to the measurement of higher d.c. voltages and of d.c. currents. In these cases care should be taken that:

a. the potential to earth (for safety reasons) does not exceed 40 V

b. the resistance, tapped off the potential divider or shunt, does not exceed the corresponding permissible source impedance (see "TECHNICAL DATA", Section 1, paragraph 2.)

4.2. For current measurements a multi-range shunt type GE 4283 is available. With resistance tappings of 10, 100 and 1000Ω, in combination with the sensitivity steps 1, 2, and 5 mV/cm on the SERVOSCRIBE M, current sensitivities from 1 to 500μA/cm are obtainable in steps of 1, 2, and 5. The shunt is of class 0.1 and the total accuracy of current measurement is therefore better than 1.1%.

4.3. It is also possible to obtain current sensitivities of 1, 2, and 5 mA/cm, if a higher voltage drop, resulting from the use of the sensitivity steps 10, 20 and 50 mV/cm can be permitted.

SECTION 4.

ACCESSORIES SPARES, AND SERVICE

1. ORDER CODE FOR ACCESSORIES

Shunt 1 to 500 μA/cm	GE 4283
Sapphire stylus (for wax paper)	Zb 333
Felt nylon-tip pen for standard paper (supplied only in packs of 5)	
felt nylon-tip pen, red	Zb 317/1
felt nylon-tip pen, blue	Zb 317/4
Chart rolls (supplied only in packs of 10)	
wax pressure sensitive paper	Zb 313
standard ink	Zb 314
Graph sheets (supplied only in packs of 10 pads)	
pad (25 sheets) wax pressure sensitive	Zb 315
pad (25 sheets) standard ink	Zb 316
Cable kit (6 connecting leads)	Zb 329

2. SPARES AND SERVICE

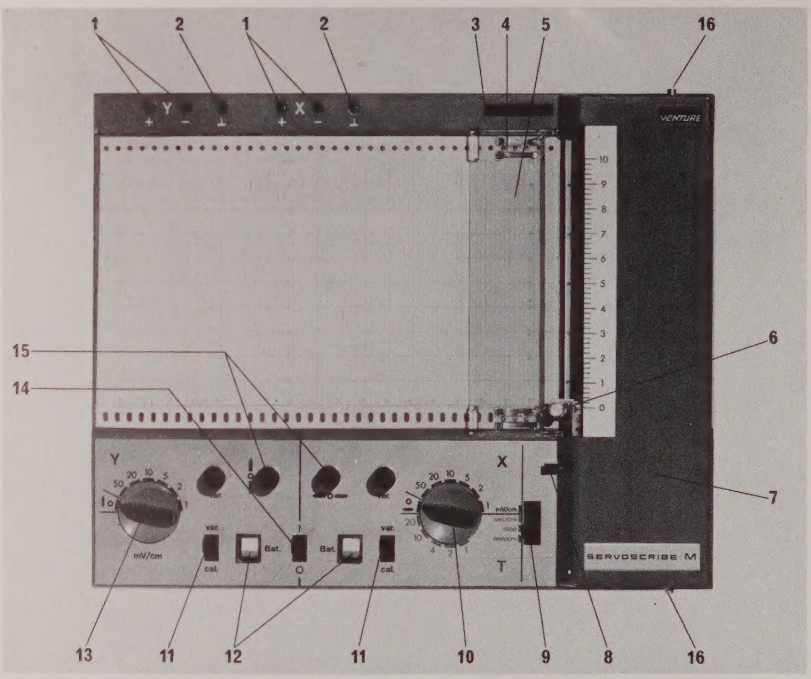
If spare parts are required for this recorder please state the model and serial number (to be found on the underside of the instrument), and address your order to:

Spares and Service Department,
Smiths Industries Limited,
Industrial Instrument Division,
Waterloo Road,
London, N. W. 2.

Telephone: 01 - 452 3333 Ext. 4266

The part numbers quoted in paragraph 1. above will assist us in progressing your orders for normal running spares and should be used when these parts are required.

Due to the careful design and reliability of this instrument, the likelihood of the necessity occuring for its return for attention is small. Should the occasion arise, you are recommended to return it to the above address. Ink cartridges and batteries should be removed. Care should be taken to ensure that it is adequately packed, to avoid transit damage and a note enclosed informing our Engineers of the faults which have been found. Not least of all, please remember to enclose your own name and address.



1. Signal inputs (sockets)
2. Screen (guard)
3. Chart position control wheel
4. Pin wheel
5. Chart guide and tear-off ruler (removable by pushing both edges to the right)
6. Pen support with sapphire stylus for wax paper (interchangeable with felt nylon-tip pen)
7. Top cover plate (removable by pressing both pins 16 inward)
8. Pen lift lever
9. Slide switch for xy respectively yt recording and chart drive switch 1 : 60
10. Sensitivity switch for "X" and chart speed switch for "T"
11. Switch for fixed (cal) or variable (var) sensitivity; sensitivity control (var) above
12. Meters for battery condition
13. Sensitivity switch for "Y"
14. Battery switch (1 = "On," o = "Off")
15. Zero and suppression control
16. Pins for top cover plate

Figure 13 SERVOSCRIBE M RECORDER TYPE RE 501.20

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